No. 11.— *Two new species of Ascodipteron.*

By Frederic Muir.

One rainy evening in July, 1908, when sitting on the veranda of the Hotel in Amboina, two bats (*Miniopterus schreibersi*) came flying round after the insects attracted by the light and shelter. Wishing to procure specimens of Nycteribiidae I caught them in my insect net. Upon examining them I observed a Streblid (*Nycteribosca amboinensis* Rnd.), crawling over their bodies in great numbers, and turning back the long fur around the head, I found at the base of the ear, a small swelling with a minute white body protruding from the side (Plate **1**, fig. 1). Dissected out of its host the flask-like shape of the protruding white body revealed it to be the imbedded female of a species of Ascodipteron (Plate **1**, fig. 2).

Wishing to learn more about this interesting insect, and if possible, to procure the larva and male, I told my collector to bring me as many bats as he could catch. During the course of a couple of weeks I examined over one hundred bats consisting of five or six species. I soon notice that only one species of bat (*Miniopterus schreibersi*) was attacked by the Ascodipteron, twenty-eight per cent of them being infested by this parasite. Most of the Nycteribiidae and Streblidae were also found upon the same species of bat. It is possible that the bats can scratch the Ascodipteron out as I found several with the skin broken at the base of the ear; or they may help one another to rid themselves of their parasites, as I have often seen bats resting side by side biting among their neighbor's fur.

That the several species of Pupipara infesting bats in this part of the world are not the rare insects that they are stated to be elsewhere, is shown by the following list.[1]

[1] *Lipoptena tolisina* and *Penicillidia progressa* are Dr. Speiser's manuscript names and will be described together with the new species of Listropodia.

Number of bats examined.		Number of parasites found.	
60	*Miniopterus schreibersi*	100	*Lipoptena tolisina* Speiser
		50	*Listropodia*, sp. nov.
		30	*Penicillidia progressa* Speiser
		180	*Nycteribosia amboinensis* Rnd.
		28	*Ascodipteron speiserianum*, sp. nov.
25	*Emballonura nigrescens*	3	*Raymondia pagodarum* Speiser
10	*Nyctinomus sp.*	5	*Lipoptena tolisina* Speiser
6	*Myotis adversus*	16	*Listropodia* sp. nov.
		12	*Nycteribosia amboinensis* Rnd.

The Ascodipteron always occupied the same position in the host, namely, under the skin at the base of the ear. Out of the seventeen bats bearing this parasite, that I examined, one had three specimens, two by one ear and one by the other, nine had two specimens and seven only one specimen.

I placed many bats, bearing these parasites, in cages but they refused to eat any of the insects I supplied them with, and died within forty-eight hours. In spite of this I was fortunate enough to procure five pupae of Ascodipteron and three of *P. progressa*.

Ascodipteron speiserianum, sp. nov.

Stated briefly the life-history of this species is as follows:— The imbedded female has the posterior portion of her abdomen protruding from the host. A single egg passes from the ovarian tube into the uterus, where it hatches in the usual pupiparous fashion, and the larva, fed by the contents of the nutriment-glands, grows to maturity. It is then ejected from the uterus and falls to the ground, where it immediately forms a puparium and pupates. The adult fly emerges in from thirty to thirty-three days and is then a perfectly normal insect, with fully developed legs and wings. A hiatus now occurs in my knowledge of the life-history, as I could not get the sexes to copulate in captivity, but I anticipate that this takes place in a normal manner whilst the female still has wings. The female then seeks her host, and by the aid of the series of chitinous blades at the end of her proboscis, cuts through the skin, she then gets rid of her legs beyond the trochanter and her wings; her abdomen enlarges and engulfs the thorax and head, so that eventually they lie at the bottom of a pit, at the anterior end of the abdomen, as if they had become invagi-

nated. The male, at least in this species, remains external, his proboscis not having the necessary weapons to cut through the skin of the bat.

Most of the bats were caught in the Batoe Lobang, a cave situated in the hills, a few miles southwest of the town of Amboina, which in the rainy season is flooded with from six to twenty inches of water. In my breeding cage one of the fine full-grown larvae fell into some water and pupated floating on the surface. It is therefore possible that some of the larvae ejected while the cave is flooded may escape destruction.

I have named this species after Dr. Paul Speiser, the well-known authority on the Pupipara, to whom I am indebted for the identification of the Streblidae and Nycteribiidae mentioned in this paper.

The imbedded female. The presence of the parasite makes itself visible as a small swelling at the base of the ear of the bat, with a small pearly-white body protruding from one side (Plate 1, fig. 1). Viewed under a lens of medium power the exposed end is seen to have an opening running horizontally across the top; this is the vagina or opening of the large uterus. The insect has the power of extruding or withdrawing the edges of this opening. When fully extruded a small dark spot, the opening of the rectum, is visible dorsad of the vagina. A little above this are four spiracles, the inner pair nearer the anus than the other; a pair of dark spots bearing short bristles lie between the inner spiracles and the anus. Ventrad of the vagina is another pair of spiracles. A row of small dark bristles circle the vagina in line with the spiracles, several irregular circles of similar bristles are situated a little further forward.

Dissected out of its host the parasite appears as a semitranslucent, pearly white, flask-shaped body (Plate 1, fig. 2) from four to five millimeters long and two to three across the largest diameter; the shape and size varying according to the stage of development of the larva in the uterus. No head or thorax is visible, but the anterior end is invaginated to form a chamber in which they are situated (Plate 1, fig. 2). Under a lens of high power the abdomen appears annulated, owing to the presence of circular body muscles just below the skin; below these circular muscles is a layer of longitudinal muscles, attached to the central part and proceeding to both ends, of the abdomen. Similar muscles, but less numerous and highly developed, are situated in the abdomen of *Nycteribosca amboinensis.*

The uterus is large and when containing a full grown larva extends more than half-way up the abdomen. There is a pair of large, short

ovarian tubes, opening into the uterus by a very short oviduct. When the uterus is empty the ovarian tubes point anteriorly, but as the larva develops the uterus pushes forward and carries the base of the ovarian tubes with it so that the ovarian tubes eventually point posteriorly (Plate 1, fig. 2, o). Muscles proceed from near the middle of the external walls of the uterus to the abdominal wall, and together with the longitudinal abdominal muscles, regulate the movements of the uterus for ejecting the full grown larva.

A pair of small glands,[1] spermathecae ? (Plate 1, fig. 2, spr.), open at the base of the oviduct and below these, in a central position, is the short common duct of the two sets of *nutriment glands* (Plate 1, fig. 2, *ng*). A set of these glands lie on each side of the body, each set consisting of three ducts with small, round, glandular cells, situated symmetrically along each side. The three ducts meet in a common duct before joining the opposite set of glands to form the common opening. These glands reach to the anterior walls of the abdomen and then turn back. *Cyclopodia albertisi* and *Nycteribosca amboinensis* show a similar condition except that the glandular cells are bunched together at the end of the nutriment ducts. In all the specimens of Pupipara that I have examined one of the ovarian tubes is always small and apparently not functional. The nutriment glands appear to be modified colleterial glands.

This form of female genital organs is common to the Pupipara and several species of viviparous Muscidae (*sens. lat.*) *i. e.* the genus Glossina, *Dyscritomyia hawaiiensis* and several Malayan species I have not yet identified. Among the Tachinidae some of the oviparous and viviparous species have greatly enlarged uteri, but, so far as I know, none have the pair of simple ovarian tubes. *Dyscritomyia hawaiiensis* carries the young larva about in the uterus for many days before depositing it, but the larva does not appear to increase in size while in the uterus.[2]

The stomach, beyond the thorax, is long and thick, the intestine long and thin, slightly enlarged in the rectum. There are two Malpighian tubes (one pair) joined together and entering the intestine by a common stalk. I can trace no "rectal glands." Both *Cyclopodia albertisi* and *Nycteribosca amboinensis* have two pair of Malpighian tubes and four "rectal glands."

The abdominal tracheae just behind the spiracles are large, but soon break up into smaller tubes. Those leading from the ventral

[1] Only one is shown in the figure.

[2] I am indebted to Mr. F. Terry for information about this species.

spiracles do not appear to join one another, or to be in communication with the dorsal ones, but each sends off two or three longitudinal branches. The four dorsal ones join and form a reticulation a little beyond the spiracles, then continue as four main longitudinal branches, which proceed to the various organs of the body and send off small branches to the muscles. I can trace no other spiracles in the abdomen. In the thorax there is a large spiracle in the episternum and a small and very obscure one near the halteres. I could not follow the connection between the abdominal and thoracic tracheae through the small abdominal foramen.

The head and thorax can be moved forward and backward so that the end of the proboscis can be thrust out of the mouth of the invagination. They are greatly distended and appear as one, owing to the large occipital foramen and the distention of the membranes (Plate 1, figs. 3, 4). The various sclerites are isolated, often partly concealed by the distended membranes overlapping their edges, especially between the gena and the front and face. The basal stumps of the wings are present (Plate 1, fig. 3, *w*), the halteres are large and intact (Plate 1, fig. 4, *h*) the legs are missing beyond the trochanter (Plate 1, fig. 4, *t*). The most conspicuous part of the head is the large thick proboscis (Plate 1, fig. 3, *p*) which projects forward, bearing fourteen sets of chitinous blades at the end. This proboscis is unique among flies, but I hope to show that it is a modification of a normal muscid type developing along certain lines indicated in certain other species of Pupipara.

The larva. The full-grown larva is about 1.5 mm. long and 1 mm. across the largest diameter, oval, semitranslucent and pearly white (Plate 1, fig. 5). On the posterior end there are four curved, chitinous ridges, the spiracles, which under a lens of high power appear serrated; the dorsal is longer than the ventral pair. Between the anterior ends of the ventral pair is a small dark spot, the anal mark. At the anterior end, in a slightly ventral position, is a small opening leading to the stomach; no mouth-hooks are present.

Upon examining the larva in certain lights the tracheae can be distinctly seen (Plate 1, fig. 5). The spiracles on each side give off large tracheae which meet and continue to the anterior end, giving off ten dorsal and ten ventral branches. The first dorsal branch, counting from the spiracles, runs backward and does not coalesce with its fellow on the other side; the following six coalesce with those on the opposite side, while the three anterior ones do not. The first ventral branch runs backward and, along with the following five, which join

one another, does not unite with the corresponding branch on the opposite side; the anterior four appear to unite with those on the opposite side. Small branches ramify among the body muscles and their ends often appear to anastomose.

The spiracles of the larvae of Pupipara afford good characters by their position, size, etc.

As little is known about them I describe several. These descriptions refer to the adult larvae taken from the uteri, for in the Nycteribiidae the larvae change their shape immediately they pass out of the uteri.

The larvae of *Lipoptena tolisina* Speiser (Plate 2, fig. 6) is oval, about 1.27 mm. long and .72 mm. along the largest diameter, with the posterior end slightly pointed; at the anterior end there is a small constricted portion, across which is an opening leading to the stomach. There are two pair of spiracles, the anterior situated in a dorso-lateral position, about the middle, the posterior near together at the end of the body, standing slightly above the surface.

The larva of Listropodia sp. nov. (Plate 2, fig. 7) is about 1.27 mm. long and .8 mm. along the largest diameter, ovoid, thicker anteriorly, a small constricted portion indicates the anterior end, with the opening into the stomach across the top. The anterior pair of spiracles is situated in a dorso-lateral position, slightly behind the middle line, the posterior pair is situated at the end of the body and does not stand above the surface of the body.

The larva of *Penicillidia progressa* Speiser (Plate 2, fig. 8) is about 1.6 mm. by 1.2 mm., ovoid, the posterior end being the thicker. The anterior end bears a small head constriction, with the entrance to the stomach. The spiracles are in nearly the same position as Listropodia, sp. nov.

In *Cyclopodia albertisi* the larva is very similar to that of *P. progressa*, but the spiracles, situated in nearly the same position, are very light in color and difficult to see.

The larva of *Nycteribosa amboinensis* (Plate 2, fig. 9, *a b*) is about 1.5 mm. by 1.2 mm., an irregular ovoid, distended on the ventral side, sometimes to a great extent, and slightly flattened dorsally; the anterior end is bluntly pointed, but does not bear a constricted head-piece. The anterior spiracles are situated a little less than a third from the end and are far apart; their outline crescent-shaped, the posterior spiracles are near together, on the bluntly pointed posterior extremity, one slightly dorsad of the other, not symmetrically side by side; they stand out from the body wall and their outline is round.

The position of all these larvae in the uterus is similar, the anterior constricted portion, bearing the mouth, being in contact with the

opening of the "nutriment" gland. The appearance of the contents of these glands and the contents of the stomach are the same under a lens of high power, and they have a similar chemical reaction.

The puparium. The full-grown larva is ejected from the uterus, falls to the ground and pupates where it falls. At first pearly white, it soon turns yellow, and in about an hour hardens to a dark brown puparium, of similar size and shape to the larva. No anterior spiracles, or "horns," appear, but the thoracic tracheae of the pupa are attached to two spots on the operculum, in a similar position to the anterior pupal "horns" common to many of the Cyclorrhapha. The operculum is large, the posterior margin running in a curve across the dorsal surface, about one third down, and continuing in a curve to the anterior edge, where it is slightly emarginate. There is no line of dehiscence running ventrically.

The position of the head of the male pupa is normal, but its small size compared to the great operculum would suggest a ptilinum being of little use. In the female the enormous labium is bent under and rests on the sternum, a position it cannot take up when hatched and hardened. Part of the notum and the face and frons are brought in contact with the inner surface of the operculum, and it appears to be the distention of the membrane, especially between the gena and face and frons, that forces it off. The pupa state lasts about thirty days.

The puparia of the two species of Nycteribiidae that I know differ very considerably from that of Ascodipteron. In *P. progressa* the full-grown larva, when passing out of the uterus, becomes greatly flattened, especially on the ventral surface, and is held by its anterior end for a short time between the external flaps of the vagina, its ventral surface being pressed against the skin of its host, generally near the junction of the wing-membrane with the body or limb. The chitinous exudation that covers the soft larval skin, to form the puparium, first appears along the edges of the flattened ventral surface and fastens it to its host, then covers the dorsal surface, but does not appear on the ventral side, that side remaining a soft membrane through which, if carefully detached from the host, the pupa can be seen developing. The larval spiracles remain distinct and stand up above the surface. No anterior pupal spiracles, or "horns" appear, but the pupal thoracic tracheae are attached to two spots on the inner surface of the operculum, and can be faintly discerned externally. The operculum is large, the posterior edge curving across the dorsal surface near the middle, slightly in front of the anterior spiracles,

and continuing along the sides to the front; no line of dehiscence runs towards the ventral surface. The position of the head of the pupa would prevent the use of a ptilinum, as the legs are folded over the head and thorax, the femoratibial joints meeting in the middle line (Plate 2, fig. 10). A movement of the legs would force off the operculum.

The puparium of *L. tolisina* is flattened and fastened to the host as in *P. progressa.*

The winged female. After from thirty to thirty-three days in the pupal state, the imago makes its appearance fully winged and with perfect legs (Plate 2, fig. 12, *a*). It is of a uniform light reddish brown color, 1.6 mm. long with large rounded wings 2 mm. long. The costal vein ends slightly beyond the third vein and bears short bristles; auxiliary vein absent; first vein strong, evenly and slightly curved, joining costal slightly before middle, bearing few bristles; second vein stout until junction of third vein, then thins off, joining costal slightly beyond middle; third vein strong, arising from near base of second, joining costal slightly before its end, bears few bristles; an exceedingly weak branch, indicated by a fold in the wing, arises near its centre and reaches the margin a little beyond the apex; fourth vein stout at its base, thinning out beyond the cross-vein; fifth vein appears as fold in the wing; cross-vein very oblique, appearing as base of vein three (Plate 2, fig. 11, *c. v.*). The legs are fairly long, tibiae slightly curved outwardly, metatarsus as long as the following three joints together; claws simple, empodium large, and bearing hairs somewhat like the onychium of Rhipiceridae. Front legs well separated from the hind pair, with coxae far apart; coxae of third pair nearly meeting in the central line; legs covered with short hairs but no special bristles. Thorax large, slightly compressed laterally, distinctly deeper than broad; notum moderately convex; scutellum small. The sclerites are covered with short hairs, and are well separated by the connecting membrane.

Owing to the enormous size of the proboscis, the distention of the membrane between gena (Plate 2, fig. 12, *g*) and frons and face and to the large occipital foramen, the head and thorax appear as one piece. The face and front form one piece detached from the gena, and whatever other sclerites the head may possess, it continues in the same curve as the notum. A pair of large sclerites form the sides of the head (Plate 2, fig. 12, *g*) and meet beneath. The proboscis is a chitinous, broad, dorso-laterally flattened, blunt cone, with a base somewhat wider than the head or notum, and about half as deep as wide, rounded

off bluntly at the end. This forms the outer tube through which a smaller inner tube runs, the two being connected by a membrane, at the apex. Arising from this membrane, and radiating from the inner tube, are fourteen rows of chitinous blades. Dorsally there are six rows, the inner blades being long, narrow and curved slightly forward and sidewards at the tips; the outer blades being shorter and curved backward (Plate 2, fig. 13); ventrally there are four rows, their blades being short, broad and curved backward (Plate 2, fig. 14). The anterior edge of the outer tube is not even, but runs back laterally, thus leaving a large membraneous surface at the sides in which the two rows of large broad blades (Plate 2, fig. 15) are set. By drawing back the inner tube all the blades are drawn into the outer tube and become in great part concealed, as they generally are in living specimens. The curved, hooked dorsal blades are evidently used to drag the insect into the wound cut by the ventral and large lateral blades, as they could not be used as cutting blades. The proboscis has a slight range of vertical movement on its point of juncture with the head, but it could not be used to sever its wings and legs. The antennal pits are narrow, transverse slits, through which the ends of the antennae project. The antennae are two-jointed, the second joint round, with a finely branched arista. Maxillary palpi and eyes missing.

The abdomen is membraneous, whitish, basal two thirds covered with very fine irregular bristles; the distal third, exposed in the imbedded female, bears longer and darker bristles. The method by which, and time when, the female gets rid of her legs and wings I could not discover, nor could I get the sexes to pair in captivity. I found no trace of legs or wings in the cavity formed under the skin of the bat, so that they must be discarded before she becomes fully-imbedded. It is probable that the growth of the abdomen over the thorax and head is rapid, as I found but one specimen which was only partly so covered.

The male. Head small, covered with short bristles; notum overlapping the vertex; occipital foramen large, but much smaller than in the female; eyes absent; antennal pits large, taking up the greater portion of the anterior part of the head; antennae two jointed, first cup-shaped, bearing large bristles, second round, bearing a stout arista with bifurcated end, covered with branched hairs, anterior part studded with "sense pits." Front rounded, face receding, gena (?) (Plate 2, fig. 12b, *g.*) large; proboscis bulbous, broad, short, projecting anteriorly, with minute tip, set far back under the head (Plate 2, fig.

12b, *p*); maxillary palpi small, spatulate, arising from the small oral membrane (Plate **2**, fig. 12b, mp.).

Wings, legs, and thorax as in the female, except that the male thorax has a much smaller foramen and the sclerites are more compact.

Abdomen pointed, membraneous, whitish, covered with small bristles, no definite segmentation. Posterior portion pointed and chitinous, forming the genitalia, which is on the same plan as *Nycteribosca amboinensis* (Plate **2**, fig. 18). The penis is a long flattened tube, with chitinous sides, articulated to a thin chitinous basal lever, for the attachment of muscles (Plate **2**, fig. 18, *p*). The penis-guide is a curved, thin, long sclerite, expanded at the end into two pointed flaps, which turn up dorsally and unite above, thus forming a short tube through which the penis passes (Plate **2**, fig. 18, *p. g.*); below the penis-guide is another pair of flaps with three short, stout chitinous bristles at the end.

Homologies of the female trophi. *The oral membrane.* The proboscis of the female differs so greatly from that of the male, and from any other fly known to me, that a comparison with some allied forms may be of interest. I have taken Dr. G. Dimmock's [1] interpretation of the trophi, which, in its main features, is the same as Dr. H. J. Hansen's.[2] I can follow neither Prof. J. B. Smith [3] nor Mr. W. Wesché [4] in theirs.

In the more generalized mandibulate insects a suture marks the division between the head-capsule and the labium, maxillae, and clypeus, and between the clypeus and labrum. In the majority of Diptera these sutures are greatly increased and form a connecting membrane, which I shall call the *oral membrane.* In the Nematocera it is not greatly developed, in some of the Brachycera (*i. e.* Bombyliidae) it is large, but it is among the Cyclorrhapha that it reaches its greatest development. In many of the Calyptratae it forms a large membraneous cone, on the apex of which the labrum and labium are situated. If the muscles controlling the pharynx of Hippobosca be cut, the proboscis can be drawn out and is then seen to be situated on a membraneous cone; when the proboscis is drawn right in the cone is invaginated (Plate **2**, **3**, figs. 19–20, *om*). In Haematobia and Glossina

[1] The anatomy of the mouth-parts of the sucking apparatus of some Diptera. 1881.

[2] Dipterernes Mundale. 1883.

[3] Contribution toward a knowledge of the mouth-parts of the Diptera. Trans. Amer. Ent. Soc., 1890, **17**.

[4] The mouth-parts of the Nemocera. Journ. Roy. Micr. Soc. 1904, and later works.

we can see the intermediate forms between the muscid and hippoboscid types (Plate **3**, fig. 21). In *Cyclopodia albertisi* and *Nycteribosca amboinensis* (Plate **3**, figs. 22–23) the proboscis is situated far back under the head, and has but a limited movement; the dorsal part of the oral membrane forms the anterior part of the head, from which the oral membrane stretches back to the base of the proboscis (Plate **3**, figs. 22–23, *om*). The same condition is found in the male of *Ascodipteron speiserianum*. In the female it is difficult to distinguish the oral membrane, on account of the great expansion of the head, but it must be the membrane between the face and gena and the proboscis. The great expanse of oral membrane in the Muscids is mostly due to the reduction of the clypeus and maxillae.

The pharynx. The pharynx is the anterior part of the oesophagus, highly chitinized, flattened dorso-ventrally, the lateral edges being turned up to form the *dorsal arms* (Plate **3**, figs. 20–30, *da.*). This forms the fulcrum of many entomologists. In many of the Orthorrhapha (*i. e.* Culicidae, Bibionidae, Dolichopidae) the dorsal arms are attached to the clypeus, which has little or no movement. This type can be called the "fixed" pharynx. In some of the Orthorrhapha (*i. e.* Asilidae) the lateral edges of the pharynx are turned up slightly but are not prolonged into dorsal arms and are not attached to the clypeus; the pharynx is then "free." In the "protrusile" type (*i. e.* Syrphidae, Muscidae) the clypeus is reduced to a small strip, or to two or one small sclerites, situated in the oral membrane, to which the dorsal arms are attached, or the clypeus is entirely lost and the dorsal arms meet together in a point situated on the oral membrane. In the "fixed" and "free" types the pharyngeal muscles are attached to the clypeus, but when this is greatly reduced, or absent, as in the "protrusile" type, the pharyngeal muscles are attached to the inner sides of the dorsal arms.

In those protrusile types which are capable of the greatest amount of movement, the basal part of the pharynx is prolonged into two long "basal arms" for the attachment of the extensor and retractor muscles.

The mechanism for the movement of the protrusile pharynx appears to be of a simple nature, as shown in Plate **3**, fig. 24. The pharynx, *a, b, c,* is attached to the oral membrane at the point, *a*, on which it can turn in a vertical direction; the retractor muscle is attached to the point *c* and to the back of the head-capsule and the extensor to the point *c* and to the head capsule near the oral margin. Upon the contraction of the extensor muscle the point *b* moves through the arc to *b*1, *a* being the centre of the circle.

The pharynx of Hippobosca is of the protrusile type, but greatly modified, probably owing to the flattening of the head and its position on the thorax. The dorsal arms are large, the posterior ones reduced; the anterior half of the pharynx is in the form of a thin, flattened, highly chitinized, and elastic tube. A powerful extensor muscle runs from the end of the dorsal arm to the base of the proboscis (Plate **3**, fig. 25); the stipites are articulated to the base of the labrum and attached to the pharynx by muscles and form the radii of the arc (Plate **3**, fig. 25, *b*, *b*) along which the proboscis travels when the extensor muscle is contracted. The retraction is brought about by a muscle proceeding from the base of the proboscis to the head capsule. This is the chief movement made by the insect when feeding, but the pharynx can be turned upon the point *d* as in other Calyptratae.

In Streblidae and Nycteribiidae, owing to the shape of the head, the proboscis is drawn back under the head (Plate **3**, figs. 22, 23) and the pharynx has a very limited movement. Hippobosca with the proboscis retracted (Plate **3**, fig. 20) and the head capsule around the lower part of the oral margin cut away, would represent the position of affairs in these two families. In the female *Ascodipteron speiserianum* the pharynx is of the normal streblid type, but the dorsal arms (Plate **3**, fig. 30, *da*) appear to be fixed to the edge of the head-capsule and to have no power of movement. The enormous size of the proboscis would prevent the small pharynx from moving it. The male pharynx I have not been able to examine, but the head is so similar to Nycteribosca that there can be little difference in the pharynx.

The maxillae. The maxilla of Diptera has undergone a great amount of reduction. It is found in its least reduced state in the Orthorrhapha, where there is a distinct basal part, the stipes, a free distal piece, the palpifer,[1] and a maxillary palpus. In some families the papifer is lost and the distal end of the stipes is attached to the labium (*i. e.* Empididae, Pipunculidae) to the labella (*i. e.* Dolichopidae) or to the base of the labrum (*i. e.* Muscidae). In all the Syrphidae that I have examined there is a free palpifer and in the few Conopidae I know it is absent and the stipes is attached to the base of the labrum. In some of the Acalyptratae (*i. e.* Drosophilidae) there is a free palpifer, in others it is absent and the stipes are attached to the base of the labrum, a condition found in all the Calyptratae, Hippoboscidae, Streblidae and Nycteribiidae. According to Müggenburg, Braula has a free palpifer, which is one of the reasons I cannot

[1] I use this term after Prof. J. B. Smith, it is the lacinia of Wasché, the lobus maxillae of Hansen and the scalpellum of Meinert.

place it with the last three families. In some muscids (*i. e. Musca domestica*) a small protuberance, with a few hairs attached to it, indicates the position of a rudimentary palpifer.

That the palpi in Diptera are maxillary is easily demonstrated by following them through such families as Asilidae, Bombyliidae, and Syrphidae.[1] In the Schizophora they arise from the oral membrane, owing to the reduction of the maxillae, and have only a slight muscular connection with the stipites; in a few species they are absent and a small sclerite indicates their position. In those genera in which the trophi are abortive the palpi are also absent.

The maxillary palpi are large in most of the Pupipara, although they have often been described as absent. In Glossina (Plate **3**, fig. 21, *mp.*) they arise from the oral membrane, near the base of the proboscis, the distal two thirds meeting together to form a cover for the distal part of the proboscis. In Hippobosca (Plate **3**, fig. 20, *mp.*). They arise from the oral membrane, near its attachment to the head-capsule and meet together to form a cover for the distal portion of the proboscis. In Nycteribiidae, Streblidae and the male Ascodipteron they arise from the oral membrane near the anterior (or dorsal) edge of the oral margin and cannot cover the proboscis (Plate **3**, figs. 22, 23, *mp.*). In the female *A. speiserianum* the stipites are attached to the base of the labrum, as in the Streblidae; there are no traces of palpi.

The labrum and labium. Of all the trophi of the female *A. speiserianum* it is the labium that has undergone the greatest specialization, and offers the greatest interest. In the Calyptratae the proboscis generally takes the form of a tube, in which the hypopharynx lies, the ventral, and major, part of the tube being formed by the labium, the dorsal part by the labrum-epipharynx. The labium is composed of two large sclerites, the *dorsal* and *ventral plates*, joined together by the *lateral membranes* (Plate **3**, figs. 27–32, *dp, vp, lm*). The dorsal plate is longitudinally grooved on its dorsal surface, or, to describe it more accurately, its lateral edges are curved up dorsally. The ventral plate also has its lateral edges curved up dorsally, sometimes so greatly that they fold round and partly envelop the dorsal plate (Plate **3**, figs. 28–29, *dp. vp.*) In *Glossina palpalis* the proboscis is similar to that of Melophagus but the differentiation of the globular basal and their distal portion is not so marked.

[1] I cannot follow Mr. Waschē in his arbitary method of calling the palpi maxillary or labial. His "law" does not hold good, as in some cases, where reduction of the maxillary has left the palpi isolated on the oral membrane, they still have a muscular connection with the stipites.

In the Nycteribiida, Streblidae, and male Ascodipteron the proboscis is drawn back under the head and has little power of movement. In the two latter the basal part is large, the dorsal plate of the labium is sunk slightly beneath the edges of the ventral plate. These characters are seen well in *A. amboinensis* (Plate **3**, figs. 28–29, *vp. dp.*) in which the labrum-epipharynx is short and broad and bears several large sense-pits (Plate **3**, figs. 26–28, *le.*). The lateral edges of the dorsal plate of the labium, beyond the labrum, overlap and so form a tube (Plate **3**, fig. 29, *dp.*). The ventral plate is large and enfolds the dorsal plate, which, in a dorsal view, is covered by the lateral membranes (Plate **3**, figs. 26, 29, *vp. dp. lm.*). In the female *A. speiserianum* the labrum-epipharynx is short and broad, with several large sense-pits. The basal part of the dorsal plate of the labium is Y shape in section (Plate **3**, fig. 31, *dp.*), beyond the apex of the labrum the lateral edges coalesce, the keel beneath becomes reduced and the dorsal plate forms a complete tube in which the hypopharynx lies (Plate **3**, fig. 32, *hp. dp.*). The lateral edges of the ventral plate also meet and coalesce, except a small basal portion (Plate **1**, fig. 3, *le*, Plate **3**, 30–31, *lm.*) from which the greatly reduced lateral membranes stretch down to the edges of the dorsal plate where they are in contact with the short labrum (before they coalesce to form a tube (Plate **3**, fig. 31, *lm.*). Thus the dorsal plate, beyond the labrum, forms a complete inner tube and the ventral plate a complete outer tube.

The apex of the proboscis of flies is developed into a pair of organs, the labellae, whose homologies are very uncertain and whose development in the various families differs greatly. In most of the Cyclorrhapha they are usually well developed, lobe-like and membraneous, capable of being brought together and folded away, or distended and divaricated; they form the connection between the distal ends of the dorsal and ventral plates and for our present purpose, may be regarded as the distal development of the lateral membrane. Across the surface of these organs radiate rows of incomplete taenidae, the pseudotracheae, which undergo various modifications in different families. In some of the Phoridae they are in the form of the letter U, the prongs being pointed and turned outwards, and their bases fastened to the membrane, along the inner surface are strong, two-pronged, chitinous teeth. In a small Javanese scatomyazid there are several large, strong, pointed teeth on the inner edge of the labellae, with which it impales small insects. Among the Borboridae I find *Limosina venalicia* with eight rows of small curved chitinous teeth, radiating across the labellae. In most of the blood-sucking flies the labellae

are reduced in size, but furnished with formidable stout chitinous teeth, very similar to those in Phoridae. The tip of the proboscis of *Melophagus ovinus* is set round with short, stout points. *Hippobosca equinus* has stout bluntly pointed teeth. In *Cyclopodia albertisi* the teeth are small. In *Nycteribosca amboinensis* there are several rows of small chitinous teeth, radiating from the apex of the dorsal plate of the labium to the apex of the ventral plates, across the connecting membrane (Plate 3, fig. 26, 27) which can only be seen when the dorsal plate is thrust beyond the ventral plate. The male *Ascodipteron speiserianum* has similar, but exceedingly small, teeth. In the female of the same species these teeth are developed into fourteen series of "blades" (Plate 1, figs. 3, 4, Plate 2, figs. 12–16). Abnormal as this proboscis is, yet it is only a modification of the streblid type.

The hypopharynx is very similar in all the Pupipara and forms a tube along which the saliva flows.

Conclusions.

The male of *Ascodipteron speiserianum* is a normal pupiparous fly, in habits, structure, and development so similar to the Streblidae that it is difficult to separate it from that family. The female has undergone certain modifications — specializations to meet her endoparasitic life — which must not be taken into consideration when classifying this genus. Her preimaginal metamorphosis is normal, but, when once imbedded, she undergoes a great amount of imaginal growth, which can only be compared to the growth of the abdomen of the female termite and Sarcopsylla, accompanied by a great enlargement of many of the glands of the body — *i. e.*, the salivary and nutriment glands, and by a great development of many of the abdominal muscles. The development of this fly has nothing in common with the females of the Strepsiptera.

The Pupipara I consider as polyphyletic branches of the Muscidae, the great enlargement of the uterus, necessitated by their pupiparous habit, compelling a great change in the male genitalia. Bearing this in mind I see no reason why Stomoxys and Glossina should not be placed near one another.[1] Braula I have not studied, but judging from Müggenburg's description and figures, I consider it has no place among the other families included in the Pupipara, but is near Thaumatoxena, as stated by Carl Borner.

[1] Wasché uses the difference of their genitalia to disprove any near relationship.

The homologies of the head of the female were worked out in Amboina before I had seen Adensamer's or Monticelli's papers. The former describes *Ascodipteron phyllorhinae* as having a thin rostrum and large maxillary palpi. *Ascodipteron tabulatum* is described by Monticelli as having the proboscis formed by the maxillary palpi. If this be correct then *A. speiserianum* differs fundamentally in the anatomy of its proboscis.

Ascodipteron australiansi, sp. nov.

This species from the Mossman district of North Queensland is very closely allied to *A. speiserianum* and like it occupied the same position at the base of the ear of *Miniopterus schreibersi*. The single imbedded female that I procured differs from *A. speiserianum* in the following points:— Head and thorax smaller and darker, notum more convex and hairy, spines round, the exposed posterior part of the abdomen stouter and shorter. The larva, of which there was a full-grown specimen in the uterus, has the spiracles in slightly different positions, being much nearer together than in *A. speiserianum* (Plate 2, fig. 17, *a.b., c.d.*).

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The figures are free-hand drawings of the objects as seen through the microscope and may not always be in correct proportions, except Fig. 3, 4, 11, and 17 which are in proportion. Figs. 3 and 4 were kindly drawn by Mr. W. R. Potton, but unfortunately he had only shrunken spirit specimens.